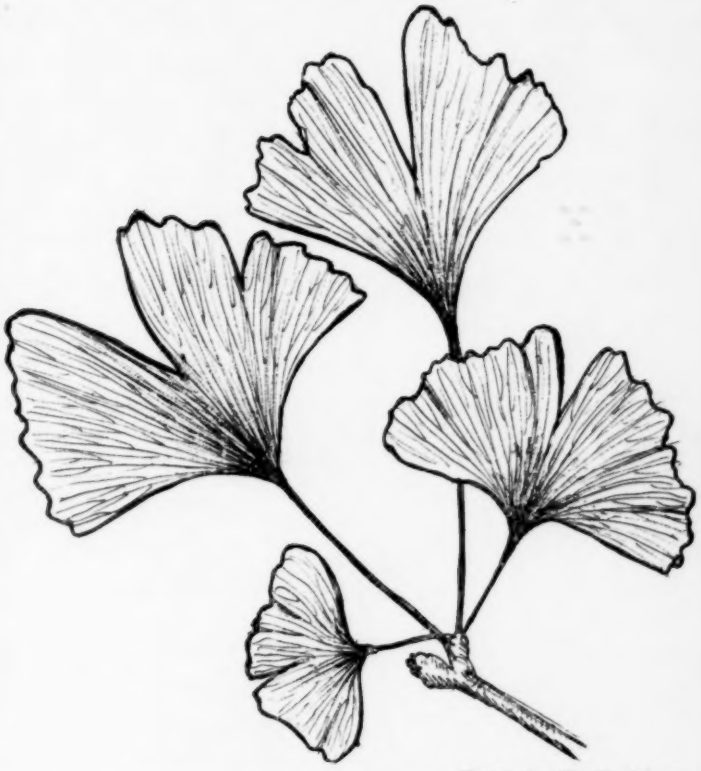
Earth Science

Rockhounds' NATIONAL Magazine



Sketch by W. H. Allaway.

GINGKO BILOBA: Our Oldest Living Tree. The last surviving representative of a botanical species, genus, family and order all in itself. Having made its appearance among the first of the seed-bearing plants near the close of the Paleozoic Era and persisting unmodified down to the present age, it is truly a Living Fossil. (See page 22)

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Editor's Memo Pad

SPUTNIK JITTERS! ! If you've got 'em, shake out of them! Ye Ed., perhaps, has a half-baked philosophy that something good can come out of almost anything, even evil. Experience and/or adversity may, indeed, be a dear teacher, and so perhaps the fact that we were caught napping in this instance will suggest a reappraisal of our science program, in a manner which in many respects may actually prove beneficial.

Furthermore, we may dare say, too much prosperity or success has ruined more otherwise good folk than perhaps the lack of it. The same axiom we would opine goes for nations as well, which after all are only a composite collection of many individuals. What we should like here to emphasize is, that an individual, or nation for that matter, need not be wealthy to be great, for indeed many of our greatest philosophers, teachers and scientists have been relatively poor, some even may have lived in or experienced some degree of poverty as a part of their background.

Again, have you ever noticed how many teams which make the first touchdown, or perhaps the first score in the ball game, will finally end up by losing the game? Over-confidence may, indeed, be a determining and oft times an underlying influence in most eventualities. So often this is true in our mineral avocation, especially in the matter of amassing fine collections.

Have you ever noticed how frequently someone may start out with tremendous enthusiasm, and perhaps considerable money, and in a few short months, gather together a spectacular collection of specimens (a real Oh! My!! and Ah! Ah!! collection), and then loose interest in them almost as quickly, while on the other hand the plodder, with much less means but with much more persistance, comes up through the years with a truly great collection, which he really loves, cares for, and remains interested in through out the remainder of his lifetime, and perhaps on throughout eternity?

Doubtless there may be some of you who are now wondering just what we may be driving at, or to what good purpose the above somewhat divergent and rather loosely connected paragraphs may be put, in other words, just where does Earth Science come into the picture. The point we are attempting to make is this: of all of the sciences Earth Science is the most basic, inasmuch as all other sciences rely in one way or another upon the materials and properties of the physical earth; it is truly the father of them all.

As an orientation course in the primary and the secondary schools leading to an interest in and the selection of science as a major, it has no substitute. As an educator, it has long been our observation that the pattern or field of life long interest is well established before the student enters high school; therefore, if it is actually more and better scientists that we are so sorely in need of to maintain and preserve "our way of life", educators, if they are so inclined, should place much more emphasis upon the simpler sciences in the elementary, grade and junior high schools. There is scarcely a child that cannot be interested in rocks and pretty pebbles, and so this may be the opening wedge which undoubtedly should be taken much greater advantage of if we are to accomplish this desired purpose.

Now then, where do you personally as rockhounds come into the picture? Simple enough, boost Earth Science (and other sciences as well) in your local schools and among your Boy and Girl Scout Troops. Take courage to interview your teachers and principals, and urge them to consider placing and teaching the subject in their courses at all levels. Some of them,

no doubt, may in all seriousness ask you, "Just what is Earth Science", and if so just be patient and start in and do a good job of teaching yourself. Tell them what it is all about, and explain all of its good points and advantages, as many of them will have only the vaguest idea about it. Show or convince them that Earth Science does actually have an important nitch in our educational program, and that we depend upon them as individuals to help us put it where it belongs. Do not fail to enlist the help of your club or society to aid in the project.

Now you should reread the first four paragraphs, observe such analogies as it may be pertinent to our present science education predicament and derive such comfort as you may.

Persons & Events

For the benefit of our friends to the Southwest, we take pleasure in calling your attention to important shows which will be well worth traveling many miles to attend. First: The 1958 *Phoenix (Arizona) Gem and Mineral Show*, March 7th, 8th and 9th, held at the State Fair Grounds, at which the theme of the show will be the "Jewels of the Ancients". As a special feature of the exhibit there will be the magnificent emerald crown, "Our Lady of the Andes", containing the most precious collection of Columbian emeralds in the world, valued at four and one quarter million dollars.

Second: On April 26th and 27th will be held the 5th *Annual Show of the Wichita Gem and Mineral Society*, at the Kansas National Guard Armory, 3535 West Douglas Street, in Wichita. The Wichita Shows have always been outstanding, and this one will be no exception to the rule, and we are sure that no one who attends will be disappointed.

The hundreds of friends of *"Bill" Bingham*, will regret greatly to hear that he is experiencing a very serious illness, which attacked him suddenly at his home in St. Paul, (2100 Arcade Street), after attending the directors' meeting of the Midwest Federation in Milwaukee, on November 23.

As president of the "Midwest" he did a remarkably fine job in directing the Joint American-Midwest Convention in 1956, held in St. Paul, one of the very best ever held anywhere in the country. He is a Certified Gemmologist, author of many fine articles published in Earth Science, and an outstanding authority in the Lapidary Arts.

Mrs. Bingham writes that indications are for a speedy and a complete recovery, which is indeed very good news.

Arthur L. Flagg, national Arizona authority, has a helpful and interesting article on thumbnails and micromounts in November *Arizona Highways*. The 16 color photographs of minerals by Floyd Getsinger are spectacular in their color reproduction. Getsinger's article in the same issue tells about the equipment and procedures for photographing micromounts.

This is not the first fine article on mineral subjects written by Mr. Flagg, past president of the American Federation of Mineralogical Societies; "Beauty of the Earth" was published in the November, 1956, issue of the same magazine, which was also superbly illustrated in color photography. Copies of these issues may be had for 35c each, and Kodachrome slides at reasonable prices. Address *Arizona Highways*, at Pheonix, also the home of the author, where he is known as the "Dean of Western Mineralogists."

Our good friend *Ken Kyte* writes thus about the *Rollin' Rock Club*, whose motto is, "A Rollin' Stone Gathers No Moss", but it does gain a polish: It was formed so that rock-

hounds anywhere may belong to an official Rock Club. The rock enthusiast who lives "in the sticks" or who moves from place to place has a club to call his own. Members of regular rock clubs are welcomed too. We feel that each rock-hobbyist has something to offer the Club and we in turn have something special to offer him, membership in a club with members most anywhere. Rollin' Rock Club members always have the "welcome mat" out for fellow members. Any rockhound anywhere may join. Write to Mrs. Edith Denman, Secretary, R. R. C., P. O. Box 693, Henderson, Texas.

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Attention is called to this 1958 *Calendar of Events*—dates to remember:

American—Texas Federations
Joint Convention
Dallas, Texas, May 1-2-3-4
American Gem Society
1958 Conclave
Chicago, Illinois, March 22-25
Midwest Federation Conclave
June 19-20-21
Downers Grove, Illinois
California Federation Conclave
June 20-21-22
San Bernardino, California
Eastern Federation Conclave
August 7-8-9
Ashville, North Carolina
Northwest Federation Conclave
August 30-31, September 1
Pasco, Washington

Every club member should start making plans now to attend at least one of these great conventions. They will prove an educational and inspirational experience that you will not soon forget.

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National Science Foundation announces the appointment of William E. Benson, to the position of Program Director for Earth Science. Dr. Benson, a graduate of Yale University, is genuinely interested in all phases of Earth Science, having served as Executive Secretary of the Division of Earth Sciences of the National Academy of Sciences, from 1954-55. He also has had a wide experience as a mining engineer, and served on both the U.S. and State Geological Surveys. Certainly Earth Science interests generally and widely are indeed fortunate to have a man of Dr. Benson's qualifications serving in this capacity.

— BEN HUR WILSON, *Editor*

Midwest Club News

BERNICE REXIN, *Club Editor*
3934 North Sherman Blvd.
Milwaukee 16, Wisconsin

CENTRAL ILLINOIS ROCKHOUNDS SOCIETY will hold its annual exhibit of rocks and minerals at the Decatur YWCA, March 22, 23. The rocks in this show range from rough specimens to polished gems. It also features Indian artifacts. Visitors are cordially invited.

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CINCINNATI MINERAL SOCIETY was informed about a relatively rapid method of analyzing crystals, rocks and ores, by Dr. Harvey Sunderman on November 27, when he discussed and demonstrated how the petrographic microscope is used to identify specimens. This method involves the use of polarized light through a petrographic microscope and has been successfully used to identify opaque as well as transparent substances. Dr. Sunderman, who is an associate professor of geology at the University of Cincinnati, contributed to the development of this method. He gave special credit to Dr. R. C. Emmons and Dr. Cameron of the University of Wisconsin for refining the method.

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CHICAGO LAPIDARY CLUB held its annual open-house meeting on December 5. The guest speaker for the evening was Dr. Ben Hur Wilson, editor of EARTH SCIENCE and co-author of "Quartz Family Minerals". Dr. Wilson chose as his topic, "Quartz-Lapidary Material Par Excellence". A

Christmas tree decorated entirely with cabochons and faceted gems was a center of attraction.

Chicago Rocks and Minerals Society on November 9 viewed a color film entitled "The Bahamas—Where Limestone Grows Today". Geologist Dr. Isabel Wasson introduced the film with a brief talk on limestone, illustrated with maps and specimens. This film, which is beautiful as well as instructive, was produced by the Humbel Oil and Refining Co.

Madison Geological Society on October 7 heard Dr. Lowell Laudon, Professor of Geology at the University of Wisconsin, give an illustrated talk on "The Glacial History of the Northwest." The colored slides that were shown included the volcanic area of the Three Sisters Mountains in Oregon, Mt. Baker, the Fraser River, Hell's Canyon, Snake River and Sun Valley. They were made by Dr. Laudon during the four years that he spent doing field work in the area.

Wisconsin Geological Society viewed colored slide enlargements of crystals at its November meeting. The minute details shown in the magnified pictures made the crystals appear so different from the original specimens that WGS president, Gilbert Thill, failed to recognize one of his own beauties.

Earth Science Club of Northern Illinois on December 13 heard Jay E. Farr present his beautiful illustrated lecture on "Gems of the Bible." Mr. Farr introduced his subject with an outline of the geology of the Holy Land and a brief history of the Hebrew people, beginning with the time of Abraham, until the creation of the Breastplate of the High Priest of Judgement. This Breastplate was embellished with 12 different gem stones, and from these stones Mr. Farr developed the theme of his story.

Indiana Geology and Gem Society received honorable mention for its gems, jewelry and fossil display at the Indiana Hobby Show in November. It was noted that the IG&GS exhibit rated highest on the score of beauty. The Model Railroad Club and the Coin Club received top honors for their excellent interpretation of the show's theme, which was Travel.

Michigan Mineralogical Society is presenting a course on "Rock Identification." The course includes ten lectures and study periods and is divided into two parts. The first section is devoted to rock forming minerals and is conducted by John Mihelcic. Its program includes cutting out and assembling models of crystals. The second section, under the guidance of Dr. Andrew Mozola, is concerned with the identification of rocks. Charts and rock kits are furnished to the students for this part.

Other Societies

Miami Mineralogical and Lapidary Guild has formed a separate division for its junior members. Any junior who has completed MM&LG'S course in Rocks and Minerals is eligible to join this section of the club. This division, which is known as the Pebble Pup Club, meets every other Saturday and enjoys programs of interest to its age group.

Gemcrafters of Miami created hundreds of pieces of jewelry, ranging from baroque styles to faceted gems, to sell at the Miami Home Builders Show. For young collectors they filled dozens of mineral specimen bags. The gem material, jewelry findings and lapidary work were all donated by the club members.

RECOMMENDED READING

"THOMSONITE," by Maynard Green. December Issue of *Pick and Dop Stick*. The world's finest quality of this pretty member of the zeolite family is found on the North Shore of Lake Superior near Grand Marais, Minnesota.

"Classification of Minerals," by Arthur Johnstone. October issue of *The Conglomerate*. A discussion of the basis of mineral classification and a brief outline of its history.

Earth Science Visits Some Rock Shops

by EARL D. CORNWELL

IN THE LAST WEEK of August a road-hungry grey car, bearing two EARTH SCIENCE representatives, might have been seen heading west from the Chicago area. This was the beginning of 17 days of touring through 10 northwestern states. Nearly every day found us parked for a while beside one or more rock shops. We regret we were not able to visit many more.

A lariat thrown from Chicago at a steer in Elko, Nevada, would outline our route fairly well; across Illinois, northern Iowa, South Dakota, southern Montana on the upper part of the loop; northwestern Wyoming, Idaho, Nevada, Utah on the far end, and back through Wyoming, Colorado, Nebraska, Iowa and Illinois on the lower part.

The rock shops we visited ranged from a display case in a gas station to a full-sized mercantile establishment. It is easier to generalize about their proprietors than the shops. To a man (or woman), they impress us as an independent breed and they are in the rock business because they love rocks.

Ken Stewart, of Salt Lake City, for example, went to work for Western Electric after his service in World War II. There was a strike and Ken did picket duty for a few days. "This is not for me" he decided. Now he has his own establishment near Temple Square where he cuts and polishes gemstones. He also has "a wife, four kids, and a mother-in-law." Ken has served as an officer in the local mineralogical society and enjoys the confidence of Salt Lake people. A clergyman dropped in to purchase a pair of jade cuff links while we were there. He attracts tourists and other transients by his advertising. A. J. Kline, comptroller of the Sun Valley Lodge, stopped off between trains to discuss polishing equipment and get acquainted. The talk turned to Craters of the Moon. Ken had driven up there in the days when Idaho rivaled Nevada as a gambling state. He had been allowed to wander about half an hour over the scoria beds while his companions tried to conceal their impatience to be off to the slot machines at Ketchum. We took down Ken's directions for finding Eden Valley wood north of Rock Springs, Wyoming, but bought a piece from him "just in case".

We might as well tell you the rest of the Eden Valley wood story right now. At Rock Springs we called at the Witka Rock and Gift Shop. After we had admired Mrs. Witka's Wyoming jade, we mentioned we were about to start on a hunt for Eden Valley wood. There was an area nearer than the one Ken Stewart had described, it seems. One of the shop's customers was helpful in outlining our route. If we had had any doubts previously that we were the world's worst direction-followers, subsequent events dispelled them. Our first wrong turn led us smack into a harvesting machine beside a silo. We backed away from that, finally crossed the "dike" of the dam north of town and came upon the road leading down along the water. Did they say "Take that road" or

"Don't take that road"? We could give you more details but you have probably guessed what we are about to tell you. Every bit of Eden Valley wood that was in that area before EARTH SCIENCE visited it was right there after we left it!

We wanted to see Gus Stevens the next morning but unfortunately did not find him in. His place looked mighty interesting. We'll be back, Gus.

While Harvey Shull's daughter was waiting for her husband to return from his duties on General McArthur's staff in Tokyo, Harvey toured the West Coast from Mexico to British Columbia with her. The interest in minerals roused on that trip has never left him. He has a well-ordered establishment on the south side of Oskaloosa, Iowa. It was coffee and cookies on the lawn for patrons a year back, but Harvey confessed he has had to discontinue that. He is still a gracious host and a magnanimous one. He saved a bad situation once by remarking to a non-paying lady patron who had just spirited a valuable nugget into her handbag, "You had better let me wrap that piece. Its sharp edges will tear the lining of your bag." It is an understatement to say that Harvey's mineral collection is outstanding. How he got some of it is illustrated by his account of a chance conversation with a Canadian couple in Miami. After returning home they drove 70 miles to pick up 67 pounds of rare Ontario scapolite to send him.

E. N. Smith, of New London, Iowa, successfully combines insurance and rockology. When you stop at Geode Industries on Main Street don't be fooled by the pretty secretary and filing cabinets full of insurance records in the front of the shop. In the rear are more types and sizes of Iowa geodes than you knew existed. When we stopped Mr. Smith had just returned from Fairfield where he had exhibited geodes and some of his cutting and polishing equipment at the annual machinery fair. He has given directions to the geode area near New London to so many visitors now, he can draw the map blindfolded. One of his problems is to devise means of transporting some of the giants he has found. Besides geodes, E. N. has some fine lapidary material.

(*To be continued*)

A man has reached the Metallic Age when he has a heart of gold, silver hair, and lead in his feet.

—*Sooner Rockologist*

A lot of people never get interested in a thing until they find out that it is none of their business.

—*Pseudomorph*

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Earth Science

JANUARY-FEBRUARY, 1958 Vol. 11, No. 1

The Nature of Magnetism

by EMERSON PUGH

THE CURRENT INTEREST in the International Geophysical Year it seems has been centered mainly on the more spectacular and more highly publicized research projects, such as the artificial earth satellite, sun-spot cycle studies, polar area studies, and nuclear fission which has recently introduced many new specialized fields of research. Among these also is the study of magnetism, which has attracted the attention of scientists for many hundreds of years.

Magnetism, that mysterious natural property of certain elements which enables them to attract others, according to early Roman writers, first came to man's attention in the pre-Christian era when a Greek shepherd in the province of Magnesia noticed that his iron tipped shepherd's crook was drawn toward certain rocks in the field where his flock was feeding. These rocks, which contained considerable quantities of magnetite or natural magnetic iron oxide, were probably the first magnets ever observed by mankind. They were regarded as being endowed with some supernatural power, but having no practical value to anyone.

Several hundred years passed, and another interesting discovery was reported, this time by traders who had made the long and dangerous trip from Europe to the far East. They brought back the news that the Chinese had a peculiar device in their boats—a small image, which, when floated in a bowl of water, always pointed to the south. No explanation was offered at first for this strange property of the image, but after a number of years some of these images were brought back by the traders. When they were examined by the scientists of the day, it was found that the images had concealed in their interiors a piece of rock. This rock was found to be similar to those rocks which had attracted the Greek shepherd's attention several hundred years earlier. It was observed that when a piece of iron was touched to these rocks or natural magnets, the iron so touched seemed to acquire the same property of attracting other pieces of iron or iron filings. It was also found that when bars of iron so magnetized were suspended horizontally by a cord fastened at their center gravity, the bars oriented themselves along a north and south line. The next step was to provide these bars with slight friction bearings at their center, and use them as the needle of a compass for aid to navigation.

Again there followed a period of years during which no further scientific or practical uses were made of either the natural magnets or the magnetized bars now made of steel. Very little was known about the laws which governed their actions, and many properties were attributed to them, which we now know to be false. For example, they were sold as infallible cures for a wide variety of diseases, the treatment consisting of stroking the affected area with the "loadstone", which they had now come to be called.

There was, however, a growing curiosity on the part of the many scientists of the day, the astrologers, alchemists and astronomers, as to what was responsible for these peculiar prop-

erties of the loadstone or magnets, and how their behavior could be modified and/or put to practical use.

The first scientific description of magnets was written by Dr. William Gilbert and published in 1600, with the title "De Magnete". Although Gilbert was probably the leading English scientist of his day, his treatise contained little which is not considered commonplace by even school children today. The outstanding feature of this book was the statement of Gilbert's theory that the earth was a huge magnet, and that the compass needle reacted as it did because of the earth's magnetic field.

Our modern ideas on magnetism go back to the middle of the 19th century, when Michael Faraday discovered the property of diamagnetism, (to resist magnetism) and when the phenomenon of electromagnetism or the production of a magnetic field by an electric current was first discovered. Two other metals, nickel and cobalt, were also found to be slightly magnetized when placed in a magnetic field.

In 1852, Weber, a German physicist, proposed a theory of magnetism which stated that all magnetic materials were made up of very small permanent magnets, molecular in size. These molecular magnets would obey the normal laws of attraction and repulsion, and the molecules could be oriented by external fields. Thus, when a piece of iron showed no magnetic properties or was in the demagnetized condition the molecular magnets had arranged themselves in closed loops with unlike poles adjacent to each other, making a closed path for the magnetic flux. The closed path prevented the field from being set up outside the surface boundaries of the material. When the bar was placed in a magnetic field, the constituent molecular magnets rearranged themselves to follow the external field, and poles appeared at the surface of the bar. With the removal of the external field, the forces of thermal agitation broke up this orderly arrangement of the molecular magnets. As the molecular magnets tended to return to their old closed path configuration, the bar would seemingly lose its magnetism.

The explanation, while not completely satisfactory, provided an answer to many of the common questions about magnetism, and was generally accepted as the best theoretical treatment of the phenomenon. The scientific world however, still had certain reservations about the theory, and continued to search for a better explanation.

The first step toward our modern theory was taken in 1907 by Weiss, who propounded the domain theory. This theory stated that magnetization was due to small regions or domains in which the material was magnetized to saturation along the lines of easy magnetization. In the case of iron, this would be along the edges of the individual molecular crystals. The direction of magnetization varied from one domain to the next. In a demagnetized sample of material the domains were so oriented that the fields did not extend beyond the surface of the sample, and consequently no external evidence of the field was noticed. If the material was placed in a magnetic field, those domains whose orientation corresponded to the direction of the field would increase in size, while those whose orientation was at right angles or in the reverse direction would decrease. This resulted in the appearance of poles at the surface of the material. As the strength of the field increased, the domains whose directions approximated that of the applied field continued to grow, as the remainder of the domains decreased. This continued until all domans had the same orientation. If this orientation coincided with that of the applied field the material was in the condition known as saturated. If the field was at an angle with the direction of easy magnetization, that is, at an angle to the crystal edges, further increases in the field resulted in a reorientation of the domain field out of the axis of easy magnetization until it was parallel to the applied field.

This is shown graphically in Fig. 1, which shows the four stages of magnetization. Thus, Fig. 1 -a represents the general direction of magnetization of the domains in an unmagnetized sample, where the arrows show the directions of magnetization in the plane of the page, parallel to the cube edges of their particles. The circles and crosses represent magnetization perpendicular to the page in upward and downward directions. When a magnetic field is set up through the sample, in a direction as shown in the diagram, those domains whose direction of magnetization conforms to some degree to the direction of the field will expand, as in Fig. 1-b, at the expense of the domains which were unfavorably directed. As the field is increased in strength the domains continue to expand or to change their direction to one of the axis of easy magnetization which approximates the direction of the field as shown in Fig. 1-c. If the field is still further increased, and it is at an angle with the axis of easy magnetization, the domains will be reoriented to conform to the direction of the field, as shown in Fig. 1-d.

This theory has within the past few years received a very convincing experimental verification through the development of techniques for tracing domain boundaries by the use of suspensions of colloidal magnetic powder in liquids. In this process, the polished surface of a sample of iron is covered with a thin film of water in which is suspended colloidal magnitite powder. The powder is drawn to the grain boundaries which it outlines in fairly sharp lines. When a sample of material is placed in a magnetizing winding and current is caused to flow in the

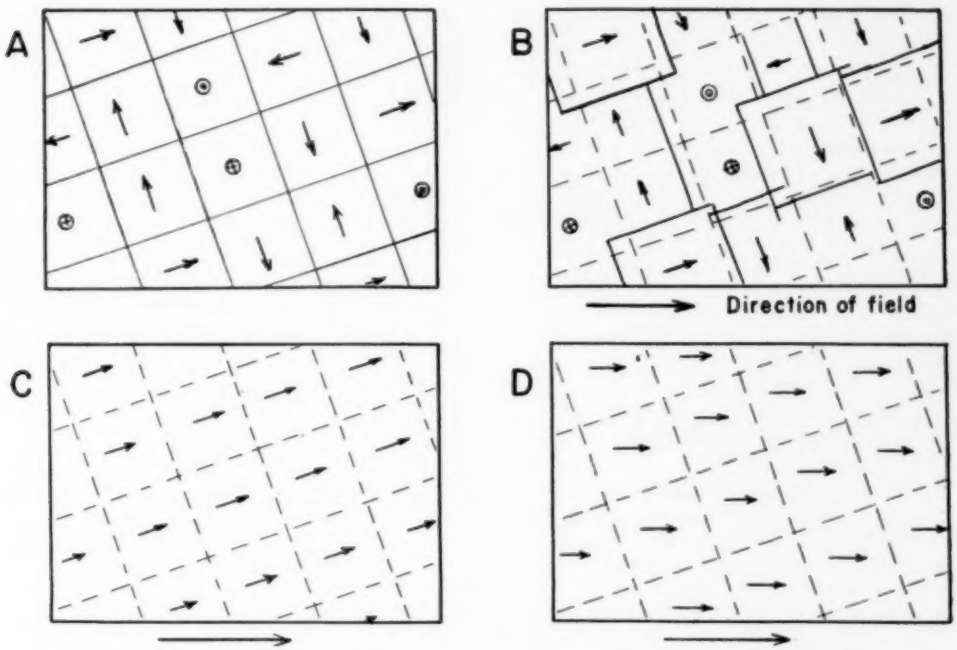

Fig. 1 - SCHEMATIC DIAGRAM OF MAGNETIC DOMAINS

A - Unmagnetized. B - Partial magnetization.
C - Easy reversals complete. D - Saturated.

winding, it will be noticed that the boundaries tend to shift, and that regions having magnetization contrary to the applied field become smaller, while those which have orientations similar to the applied field increase in size. This process can be photographed or observed visually by the aid of a microscope, and it furnishes definite evidence of the mechanism of magnetization.

The next problem was to account for the magnetic fields of the domains themselves, and to explain why some materials should exhibit strong magnetic characteristics; and others should show very weak characteristics. When we consider that our modern atomic theory holds that all matter is made up of energy in various states including positively and negatively charged particals of matter arranged in different orders, it is possibly difficult at first to find a convincing explanation for the property of magnetism.

If we go back to the early part of the 19th century, we find that early experimenters like Ampere made some remarkably accurate guesses as to the nature of magnetism, but due to the lack of sufficiently sensitive instruments, they had been unable to prove their theories. Ampere had suggested that the atoms were themselves magnetic because of currents flowing in the atoms, but had no means of proving the existence of these atomic currents.

In 1913 the Danish physicist Bohr proposed a new form of the Ampere atomic magnet. His theory was that the atom of any substance consisted of a nucleus having a positive charge and a number of electrons or negative charges, which were in orbital motion about the nucleus.

These electrons are arranged in a definite order, and their motion is normally within a definite radius from the nucleus. Thus we might imagine the nucleus surrounded by a number of concentric spheric surfaces, forming a series of shells or layers. The electrons distribute themselves in these shells in a definite manner. Thus helium, which has only two electrons, has them rotating in a shell concentric with the nucleus. The next heavier atom, lithium, has three electrons, two of which are located in the inner shell and the third in an outer shell. As we consider the heavier atoms we find the same arrangement continuing. Beryllium with four electrons has two in the inner shell and two in the outer shell. Oxygen with eight electrons has two in the inner shell, two in the second shell, and four in the outer shell.

Another factor must also be considered. The electrons in addition to having an angular momentum around the nucleus, also have a spin about their own axis, just as the earth has both angular movement around the sun and spins on its own axis. This spin also produces a magnetic field, the direction of which depends on the direction of the spin. It was found that as the number of electrons increased, the positive and negative spins tended to balance each other. This condition continues as we examine the larger atoms, until we come to the iron atom.

This iron atom has 26 electrons, arranged as shown in Fig. 2. The nucleus has 26 positive charges. The 26 electrons of the atom are arranged with two electrons in the inner shell, one having a positive spin and one having a negative spin; two electrons in the inner sub-shell of the second shell, again one having a positive spin and one a negative spin, and three positive and three negative spins in the outer sub-shell. The third shell has three sub-divisions, the inner one with a positive and a negative spin, the center one with three positive and three negative spins. The outer subdivision breaks the balance, for in it we find five positive spins but only one negative spin. This leaves a surplus of four positive spins which is sufficient to give a definite magnetic field to the atom.

The condition of unbalance is also

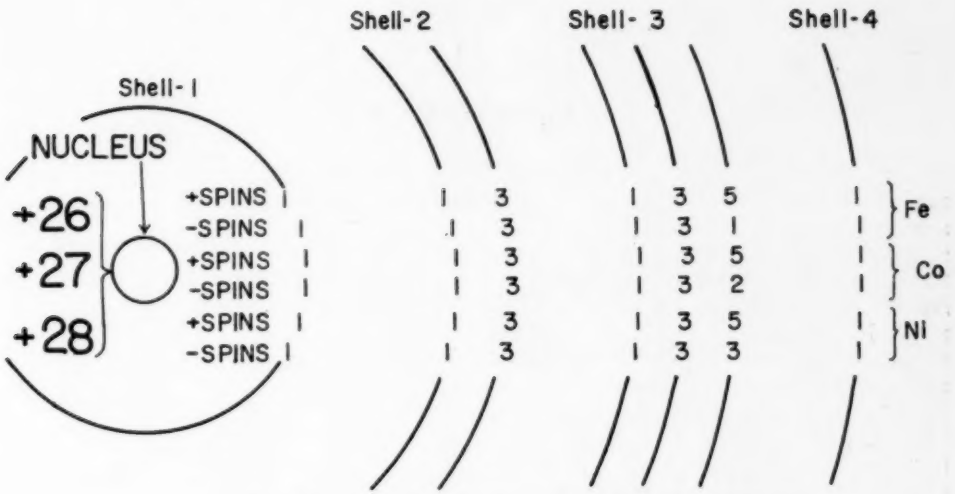

Fig. 2 - ARRANGEMENT OF ELECTRONS IN ATOMS OF MAGNETIC MATERIALS

present in the atoms of cobalt and nickel, which have 27 and 28 electrons, respectively. In both of these atoms we find the condition of balanced spins in the inner shells, just as in the iron atom. Likewise, the outer subdivision of the third shell has five electrons with positive spins, but with two negative spins for cobalt and three negative spins for nickel. This gives cobalt a surplus of three positive spins, and nickel a surplus of two positive spins. The larger atoms show the balanced arrangements which characterize the atoms smaller than iron, nickel and cobalt, and also have the same magnetic characteristics that characterize the smaller atoms.

At this point we find ourselves in the position of the wise men of ancient times. You may recall that they had a very convincing explanation for the position of the earth in the universe. The earth was held in position on the shoulders of the giant Atlas. Atlas was shown as standing on clouds. The question as to how clouds could support such a weight was unanswered. We likewise have arrived at a similar impasse. The magnetic characteristics of iron, nickel and cobalt are due to unbalanced electron spins. The reason why a spinning electron has a magnetic field is in somewhat the same category as the support of the giant Atlas. That problem will provide opportunities for our future scientists to exercise their imaginations and their skills in its solution.

About 20 miles east of Hot Springs, Arkansas, is a place called Magnet Cove, where outcroppings of magnetite or loadstone occur in abundance. It must have been at some such or similar place that the ancient Greek shepherd discovered magnetic properties of iron centuries ago. Not all of these specimens are magnetic, but where a large number are around on the ground, by scuffing them together and then picking them up and examining them closely you will find that some of them have attracted minute particles of the iron mineral out of the dust. These are the magnetic specimens for which you have been looking. The mineral magnetite is dark brown to black in appearance and quite heavy due to its iron content. Later EARTH SCIENCE plans to take up the subject of the many varieties of iron minerals.

—W. H. Allaway

Pierre Shale Fossils

by JUNE CULP ZEITNER

ALONG THE GUMBO BANKS of the major western South Dakota rivers are numerous concretions of the Pierre shale formation. These huge concretions, shaped rather like oversized hassocks, are the homes of some of the most interesting and well preserved fossils of marine origin. The mere thought of searching in the barren Dakota Badlands for giant sea creatures is intriguing to most rockhounds, but actually finding one of these exceptional cephalopods brings hundreds of collectors back again year after year.

The first time I found some of the pearly baculites and delicately sutured ammonites was an accident. I was looking for some of our rare gem quality golden barite which occurs in similar concretions. We had some of the baculites, ammonites, chambered nautilis, and scaphites in our collection to be sure. Some of them were even in their matrix to illustrate the way they are found. But until this particular day when I broke open this certain boulder I'd given little thought to these famous fossils.

The boulders have to be opened with a sledge and pry bars. I'm not much good with a heavy sledge so our usual procedure was for my husband, Albert, to take a few hefty whacks at a promising prospect and leave me to poke and pry around until I either found something or gave up.

This particular boulder did not yield any spectacular single specimen; instead it was a giant's bowl of clam chowder, a king size "sea food

MRS. ZEITNER Holds a Petrified Clam (Inoceramus) on Top of a Pile of Broken Pierre Shale Concretions.

This Straight Shelled Fossil Baculite Was the Only Fossil in This Grey Concretion.

Midwest Convention

Downers Grove, Illinois

June 19-20-21, 1958

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BE SURE and see the next issue of EARTH SCIENCE, March-April, for a complete listing of the 22 Chairmanships necessary to handle this convention.

special". I counted 8 different kinds of shells besides all the clams piled hit or miss one on top of another. I sat down on the ground and began to wonder. Why and How were all these sea animals captured in this boulder. How long ago were they slowly moving along the bottom of the sea? What were their enemies like? Were they left high and dry at low tide on a beach lined with palms like the places I have found live shells in Florida? Or were they tossed on cactus covered desert like the Texas Gulf shores?

This boulder fired my imagination and I temporarily forgot the barite. Our crystal hunt had suddenly turned to a fossil hunt. The next boulder was full of small ammonites. They were a hard shiny black with the beautiful fern-like sutures etched in white. We found many more boulders that day full of marine fossils. However we found none of the large species of ammonites which are often two feet in diameter. These large ones are usually found one to a concretion. Not all concretions of the Pierre shale formation contain prized fossils. We soon discovered that the best ones to tackle were the hump backed ones.

The Cheyenne River and its tributaries have long been the classic locality for these fossils, but the Bad, Grand and Moreau Rivers also have fossil grounds, as do many of the western North Dakota localities. We have found marine fossils on hillsides near the northern border of our state. These are not as well preserved as those from the Cheyenne area.

The Cretaceous sea in which these marine animals once lived stretched from the Gulf of Mexico to the arctic circle about 130 million years ago. The seas were warm and fringed with tropical vegetation. During the close of this period the sea gradually changed from salt to brackish to fresh in nature and subsequently the great uplift of the Black Hills area took place.

At the present time the Pierre shale formation is the surface formation of most of western South Dakota. The underlying formation is the Niobrara, and the overlying formation is the Fox Hills. Bentonite beds, clays and calcareous concretions are typical of the Pierre.

The best localities to look for the famous fossils are along stream banks, draws, edges of buttes, and areas subject to considerable erosion. Since the slate grey or bluish clays are slippery and sticky when wet, fall is the ideal time for fossil hunting. Many of the Badlands streams are dry by fall and September and October usually bring us very little moisture.

Microscopic as well as megascopic fossils occur abundantly in the Pierre. Although many species of shellfish or molluses have been identi-

To Mrs. Zeitner's Right Is an Unbroken Pierre Shale Concretion. The 3 Pieces of Yellow Calcite Crystals Found in Such Concretions Contain Small Shells and Are Fluorescent.

fied, only a few are widespread and commonly associated with the South Dakota Pierre shale formation.

The unusual appearing baculite is one of the interesting fossils of this group. Straight shelled, rather than coiled, the baculite was an early relative of the chambered nautilus. Often mistakingly called "petrified fish" or even "petrified snakes" by local inhabitants, the baculite is often as long as 8 to 10 inches and usually adorned by the distinguishing lacy sutures which also characterize the ammonite.

In the areas north of Wall and Wasta these early shells are particularly well preserved. From this region have come some of the largest ammonites, the most sought after of the entire group.

Differing from the loosely coiled Heteroceras, the ammonites have the compact spiral of a giant snail. Some species although large in diameter are quite flat with almost a razor sharp edge. The best are dark in color with the defining sutures showing up white. However many specimens carry a mother of pearl coating so irridescent and beautiful that even determined lapidaries hesitate to grind it off to reveal the sutures.

Scaphites are much like ammonites in appearance except that the shell is more ridged and horny. The petrified chambered nautilus looks almost the same as the modern species, the inspiration for Oliver Wendell Holmes' well known poem.

Another type of shell represented is the Ostrea or oyster. Various relatives of the clam (inoceramus) are common. In the northern part of the Badlands we have found large numbers of tiny clam like shells reminiscent of the present day coquina of Florida, while along the Cheyenne we have found clams so large that even a Gulliver could scarcely have eaten more than half a dozen.

Brachiopods are found occasionally. Crabs and Belemnites, a relative of the squid, are also found occasionally. Lucina, a delicate appearing shell with a present day counterpart in Florida, is a rare member of the Pierre group. A few shells similar in shape to Wyoming's turitella fossils are found, and we have one beautiful example of a shell looking like the modern Florida Turebra. It is so well preserved that even the variegated buff tones of the outer shiny covering seem to be almost in an orignal state.

The South Dakota School of Mines museum has a large collection of the Pierre shale marine fossils. The Zeitner Museum in Mission has a representative group, and many collectors in the western South Dakota area have several good examples of these fossils. Museums from all over the world used to order Ammonites from the late Tom Friet, of Scenic, South Dakota. Up to the age of 80 Tom knew where to find the "big ones," and how to free them from their matrix. He reportedly got as much as $500 for an outstanding specimen.

For the present day field-tripper I must admit that the finest Pierre fossils are not easy to come by. On the other hand, I know of at least three groups of amateur fossil collectors who were well rewarded for their efforts this past summer. Taking rough trails into remote areas in hot July weather and then pounding up rocks all day sounds like punishment for prisoners. Why people will labor 50 weeks a year in order to earn two weeks of rock hammering at 100 degrees temperatures is one of the mysteries of mankind. But if I tell you each of these collectors came out with a box of rare shells left for them by cretaceous seas, you will understand why they will be back again. Yes, and so will I.

Sometimes the only thing that keeps the human race going seems to be the lack of parking space.

—Pebbles

Ginkgo Biloba - A Living Fossil

by **Dr. Frank L. Fleener**

Early Man, in his ignorance of the world in which he lived, was prone to populate little-known areas with hideous monsters of all shapes and sizes which, he imagined, waited to devour the luckless adventurer who had the temerity to invade their domain. This misconception persisted for many centuries and as late as the Fourteenth Century their images appeared in the form of decorations on the borders of the maps of the time. The perennial appearance of the Sea Serpent, of terrifying mien, is but an expression of the old belief that fearsome prehistoric monsters still exist in the great abyss of the oceans or live hidden away in inaccessible corners of the earth.

Biologists agree that not nearly all the former inhabitants of the earth are known. Our fossil records are very incomplete and many lines of descent are difficult to trace—often completely lost. However, it is quite true that the discovery of a species of an ancient form of life does occur from time to time, as was the case when Miss M. Courtenay-Latemer, curator of the museum at East London, on the south-east coast of Africa discovered a five-foot, 127 pound fish to be a coleoanth, that had been pronounced as having been extinct for seventy million years. This was a scientific discovery of prime importance, that enabled biologists to extend the life history of the fishes near to the point where descendants of coleoanth changed and gave rise to forms that left the water and developed a way of life on land. Naturally, these changes consumed many millions of years of time to perfect. Pinpointing this fact in the development of fishes has made coleoanthus a much more important fish than his befringed appearance justifies.

The accepted definition of a fossil states that it is the remains or trace of some organism that lived in a previous geologic period, and, to some students, this statement seems to preclude the possibility of there being any such thing as a Living Fossil, the definition seemingly indicating that the organism must have died before it could leave any trace in the rocks. However, paleontologists have accumulated sufficient evidence to prove conclusively that many of our present organic forms had their inception in previous geologic periods, thus making it possible for them to assume the dignity of being Living Fossils.

The Ginkgo biloba, (two lobed), is

Neuropteris carrii: Named for J. C. Carr, of Morris, Ilinois, who was one of the earliest collectors of Mazon Creek "Fern Fossils".
Picture courtesy of John McLuckie.

probably our best example of a geologic "hangover" in the plant world. Ginkgo trees are not uncommon in this country; specimens are to be seen in arboretums, city parks, and on many private lawns. The largest specimen that your writer ever chanced to see is growing on the campus of Ohio State University, at Columbus, Ohio. It is a magnificent tree, near one-hundred feet tall, and one foot above the roots is well over two-feet in diameter. Strange to relate, none of these trees exhibits any striking beauty of form, foliage or flower, but the species owes its rising popularity to a long series of circumstances which have intrigued the fancy of man.

In the first place, Ginkgo biloba is, geologically speaking, the world's oldest tree. It is the sole survivor of a once large and flourishing family of trees that at one time literally possessed all parts of the earth, and is today the only known member of the plant kingdom to represent a species, genus, family, and order, all in itself.

The ginkgo is not only the world's oldest and most remarkable living tree, but it holds the longest continuous fossil record of any organism, plant or animal. This peculiar tree easily traces its ancestry back through the eons of time to the "First Families" of deciduous gymno-sperms - the first seed-bearing trees, which made their first appearance near the close of the Paleozoic Era, some 250 million years ago.

Fossil evidence has shown us that the present-day Ginkgo biloba has come down through at least ten-million years with so little change in the leaf form that it is quite impossible to differentiate between the leaves of the fossil and modern forms. It would appear that this strange tree has long overstayed its time on the great stage of life, yet it remains with us, a mute reminder of the dim past—a Living Fossil.

Paleontological evidence indicates that the ginkgo tree reached its greatest geographical distribution during the Jurassic period, about 150 million years ago. When dinosaurs and related reptiles ruled the animals of the land, the ginkgo enjoyed almost undisputed control of the forests. During that period it flourished in every region of the world, from the Arctic regions to the south temperate zones. Fossil remains from Oregon, Alaska, Canada, Greenland, England, across Northern Europe, and Siberia, China, and Australia testify to the great area covered by the forests of this interesting tree.

Then came the Pleistocene Ice Age, ushering in a great climatic revolution, and as the great glaciers advanced out of the north, they destroyed the ginkgo forests and other vegetation over stupendous areas. However, the destructive ice did not cover China, Korea and Japan, and there the ginkgo was able to survive through the rigors of the cold, damp, inhospitable glacial climate.

Geologically Ginkgo biloba is already extinct, surviving into the present through the reverence and care of man, and, with the fall of civilization, it may be expected to come to a belated but certain end. According to Dr. Dake, writing in the *Mineralogist Magazine*: "It is not known to grow in its native habitat at the present time, although it was recently reported that the ginkgo tree was found growing native to Mongolia. This has not been substantiated and is questionable . . . . . In the Orient the ginkgo tree is planted by Buddhist priests, who consider it as sacred. The tree has been identified with Buddhist temples and sacred gardens for a very long time. Some of these cultivated trees are a thousand or more years old, reaching more than a hundred feet in height and over four feet in diameter".

Fossil leaves of Ginkgo biloba are widely distributed, the leathery leaves seemingly lending themselves readily to preservation in the muddy shales. However, in spite of the known wide-

(*Continued on page* 28)

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(*Continued from page* 24)

spread distribution of the ginkgo forests, fossil ginkgo wood is very rare and so far has been reported from the central Washington region only, where east of Ellensburg near Vantage some twelve square miles of petrified forest have been set aside as Ginkgo State Park. This area is estimated to contain something like ten thousand petrified logs of all sizes and species.

Much credit is due for the preservation of this area, for the edification of future generations, to Prof. George Beck of the Department of Geology in the Washington College of Education, at Ellensburg. Prof. Beck was among the first to realize the scientific importance of the region and to take steps towards its preservation. As time passes the park is being developed and many fine opalized logs are being exposed to view. Its popularity is indicated by the fact that some 10,000 visitors sign the register annually.

It is quite natural that such an interesting tree should be known under different names in different places. Its common name, the "Maidenhair Tree", much used in this country, comes from the resemblance of its leaves to those of the Maidenhair Fern. In China it is known as "The Silver Nut Tree", because of the light color of the seeds. The old Chinese name "Yin-Kou", from which we derive our present name for the tree, literally means the tree with leaves like a duck's foot, a very apt allusion, you will note from the drawing. (See front cover illustration.)

Putting the Eye In Tigereye

by WALTER H. JAYNE

THE CUTTING of a tigereye cabachon with a floating eye has, for many amateurs, been a case of hope, luck, and try again. Many have never been successful in obtaining the floating eye, although, of course, the fixed eye is easy to obtain from the margin.

There is, however, a way to pre-determine the hoped for result. If you will take a slice of tigereye that has been properly cut, parallel to the grain of the fibres (a difference of 2' or 3' will make the difference between properly and improperly cut), and look across the slice at an angle of about 60 degrees, you should see the half of the slice toward you either dark or light with the far half the opposite in color to the near half.

Mark with a pencil lightly, the dividing line between dark and light, and then holding the slice in the same plane, rotate it end for end and if the light side was toward you before, it should be toward you now even though you have rotated the slice.

Again mark the dividing line of light and dark and hope your pencil marks are in the same place. Now turn the slice over so the bottom becomes the top and you should have a reverse lighting effect. If the light side was toward you before, you should now have the dark side toward you, and that will remain true if you again rotate it in the same plane.

When you look down at a 60 degree angle on the slice and see the dark side toward you, you are looking at what should be the crown of the finished stone, so place your template on the side where the light half is base and when you are through slabbing and polishing, you should have a floating eye of light, if the above directions have not confused you!

—*Trilobite*, Wisconsin Geological Society

Shop Hints on Tumbling

by DAROLL ALBRIGHT

A tumbler should have the following features:

1. It should be built in such a manner that it can be taken completely apart so that it can be cleaned properly.
2. It should be lined to keep the stones from fracturing and to cut down on the noise.
3. It should have a door in it so that you can inspect the stones at least daily.
4. It should not be less than 6" in diameter.
5. It should have six sides and be simple. The more complicated it is the more difficult it is to maintain and clean.
6. The drums should be loaded to about 2/3 of their full capacity. 1/3 of this bulk should be the stones you want to tumble; the remaining 2/3 should be a suitable carrier. Small fragments of flint, solid agate and grit material makes a good carrier.
7. It should have enough water to make a soupy mixture; inspect frequently and don't tumble any longer than necessary but long enough to remove all of the scratches.
8. Cleanliness is the word. Tumble the stones in soapy water for 24 hours between each stage of the tumbling to assure that every fragment of grit has been washed away.
9. *Patience*—you must have plenty of.
10. 30 to 45 days are required for all steps to be completed. Don't forget that a drum turning 18RPM will revolve over a million times in that period.

—*Rockhound News & Views,*
Verdugo Hills Gem & Mineral Society

BOOK REVIEW

"Iron Ore Beneficiation," by Lawrence A. Roe, Manager of Process Engineering, International Minerals & Chemical Corp., Chicago, Illinois. Published by Minerals Publishing Co., Box 85, Lake Bluff, Illinois Price $5.00, Publication date August 1, 1957.

Recognizing the many excellent publications that have been produced in the past 50 years on the beneficiation of ores, Lawrence A. Roe has now produced a book dealing with iron ores. This book is designed to cover the low grade iron ores that are now used due to the scarcity of richer deposits. It is interesting to note that a deposit that would be considered rich in an other ore would be considered poor in the iron industry. When it became apparent after World War II that considerable research would be required to meet the changing conditions, the material for this book was gathered from scattered information, much of it difficult of access, and concentrated into a useful, workable reference volume. The book is really a history of that part of man's existence known as the "Iron Age" and actually discloses that some of the techniques used by prehistoric man, such as hand sorting, are still in use today; however, modern needs have caused our progress in this field as in others to assume geometric proportions. This book will give the average citizen an opportunity to learn some of the amazing facts concerning the history of iron production in this country. It

will also indicate a comparison with other vital products such as petroleum.

The cost of up-grading iron ore has reached tremenduous figures and has required a grouping of the greatest financial institutions in the country to accomplish these projects. For those who are interested in the many processes such as washing and jigging, flotation, magnetic separation, etc., these processes are clearly outlined in layman's language.

—W. H. A.

THE ROCKHOUND'S CREED

The Rockhound's creed is a simple one
But it leads to a happy life
In a cold and ever-changing world
Where selfishness is rife.
To search the hills for gemmy rocks
And take and leave a few;
To share with those who cannot go
As others have shared with you;
To leave a camp that is clean and neat,
Unmarred by the vandal's taint;
To gain permission to come and go
Nor risk an owner's complaint;
To polish a stone to its highest sheen
And bring out its beauty rare;
Ever strive for a perfect gem
For to adorn some lady, fair;
To make of each daily hour a gem
Which may brighten someone's day;
To gaze on high with a faith serene
When he comes to the end of the way.

—Agate Pete, in *The Voice*

Have you heard the one about the ghost who backed into a lawnmower, then went into a liquor store because he heard they retailed spirits.

—*Pseudomorph*

MIDWEST FEDERATION CONVENTION

Make your plans now to attend

JUNE 19, 20, and 21, 1958

TWO NEW ITEMS BY POPULAR DEMAND

1—Field trip to BRAIDWOOD FOSSIL area, Sunday afternoon of the 22nd.

2—Exhibits at the Convention will remain open from 1 to 6 P.M. the same afternoon.

Downers Grove, Illinois
at
Community High School

Twenty Miles West of Chicago

On C. B. & Q. R. R.

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NOW IS THE TIME TO START PLANNING
FOR

INDIVIDUAL EXHIBITS
JUNIOR EXHIBITS
COMMERCIAL EXHIBITS
SOCIETY EXHIBITS

SEE MIDWEST CLUB NEWS FOR FURTHER INFORMATION